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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the 1 powder type polymer cement composition used for the half-flexible pavement of a road.

[0002]

[Description of the Prior Art]The half-flexible pavement called semi-rigid pavement is the pavement which served as the flexibility of asphalt paving, and the rigidity of concrete pavement and which it had. This half-flexible pavement is used for the crossing of the road where braking of vehicles, stop, start, etc. are performed by high frequency, for example, a bus stop, the tollgate of a highway, a gas station, etc. the place for which flow resistance, oil resistance, heat resistance, light color nature, etc. are needed. Construction of half-flexible pavement is performed by making the cement milk for osmosis permeate this open grain size asphalt mixture as grout, after paving with an open grain size asphalt mixture with large voidage of about 20 to 27% used as a parent. The curing time to traffic opening after osmosis is about 3 hours for about one day at the case where high-early-strength Portland cement is used for about three days by the case where ordinary portland cement is used for cement, in regulated set cement, or common or the case where what added quick-hardening-ized material is used for high-early-strength Portland cement.

[0003]Agitating beforehand a water resin emulsion or the mixed liquor of rubber latex and water in a construction site, it adds granular materials, such as cement and silica sand, to this, and is uniformly mulled by a mixer by this cement milk for osmosis. In order to prepare this cement milk for osmosis, when preparation of the above material not only taking time in some numbers but authorized personnel were unripe, there was a possibility of producing a compounding error. Processing of \*\*\*\* after use of a resin emulsion is also a problem. In order to improve this point conventionally, to cement 100 weight section 15 to fly ash 70 weight

section, The 1 powder type polymer cement composition for half-flexible pavement which carried out mixed adjustment of the material containing ten to silica sand 60 weight section and 0.5 to re-emulsifiability powder resin 10 weight section is proposed (JP,3-295905,A). According to this 1 powder type polymer cement composition for half-flexible pavement, fear of the compounding error at the time of preparing the cement milk for osmosis in a construction site not only disappears, but, When quick hardening cement is used for the road repair work of the hurry which needs to be finished for a short time, the adverse effect on construction of the cement milk for osmosis solidifying in a mortar mixer, an injection hose, etc. can be stopped to the minimum.

[0004]

[Problem to be solved by the invention]However, the mobility required as cement milk for osmosis of the 1 powder type polymer cement composition for half-flexible pavement of the above-mentioned composition is not high enough. For this reason, in order to obtain a desired flow value, the water granular material ratio was enlarged comparatively, drying shrinkage became large as a result and there was a problem that a crack occurred or it was inferior to intensity manifestation nature.

[0005]Even when [ which could prepare the purpose of this invention promptly in the construction site, and added regulated set cement or sudden hardening material with cement ] common or high-early-strength Portland cement is used, It is in providing the 1 powder type polymer cement composition for half-flexible pavement which can stop the adverse effect on construction of the cement milk for osmosis to the minimum. Another purpose of this invention is to provide the 1 powder type polymer cement composition for half-flexible pavement which does not start the compounding error by authorized personnel.

[0006]Another purpose of this invention is excellent in the mobility of the cement milk for osmosis, reduces a water granular material ratio, and can make drying shrinkage small, and suppresses generating of a crack, and there is in providing the 1 powder type polymer cement composition for half-flexible pavement excellent in intensity manifestation nature. The cement milk for osmosis whitens another purpose of this invention, and when coloring, there is color enhancement in providing the good 1 powder type polymer cement composition for half-flexible pavement.

[0007]

[Means for solving problem]Invention concerning Claim 1 is the 1 powder type polymer cement composition for half-flexible pavement which powder additives were uniformly mixed with cement, limestone impalpable powder, silica sand, and re-emulsifiability powder resin, and was prepared. By using limestone impalpable powder, mobility can improve, a water granular material ratio for obtaining a desired flow value can be reduced, drying shrinkage is reduced as a result, and generating of a crack can be controlled. Cement milk for osmosis whitens, and

color enhancement becomes good when coloring.

[0008]Invention concerning Claim 2 is the 1 powder type polymer cement composition for half-flexible pavement which powder additives were uniformly mixed with cement, limestone impalpable powder, limestone aggregate, silica sand, and re-emulsifiability powder resin, and was prepared. By using limestone aggregate, while mobility improves, intensity manifestation nature increases.

[0009]Invention concerning Claim 3 is the 1 powder type polymer cement composition for half-flexible pavement which powder additives were uniformly mixed with cement, fly ash, limestone aggregate, and re-emulsifiability powder resin, and was prepared. By using fly ash and limestone aggregate together, while mobility improves, intensity manifestation nature increases.

[0010]Invention concerning Claim 4 is the 1 powder type polymer cement composition for half-flexible pavement which powder additives were uniformly mixed with cement, blast furnace slag, silica sand, and re-emulsifiability powder resin, and was prepared. By using blast furnace slag, the cement milk for osmosis whitens, and when coloring, color enhancement becomes good.

[0011]Invention concerning Claim 5 is the 1 powder type polymer cement composition for half-flexible pavement which powder additives were uniformly mixed with cement, limestone impalpable powder, silica sand, powder asphalt, and slaked lime, and was prepared. Good grout description is acquired without using re-emulsifiability powder resin by using powder asphalt and slaked lime.

[0012]

[Mode for carrying out the invention]The polymer cement composition concerning Claim 1 contains the limestone impalpable powder of five to 100 weight section, silica sand of six to 300 weight section, and re-emulsifiability powder resin of two to 46 weight section to cement of 100 weight sections. The polymer cement composition concerning Claim 2 contains the limestone impalpable powder of five to 100 weight section, limestone aggregate of three to 200 weight section, silica sand of three to 200 weight section, and re-emulsifiability powder resin of two to 46 weight section to cement of 100 weight sections. The polymer cement composition concerning Claim 3 contains the fly ash of five to 100 weight section, limestone aggregate of six to 300 weight section, and re-emulsifiability powder resin of two to 46 weight section to cement of 100 weight sections. The polymer cement composition concerning Claim 4 contains the blast furnace slag of five to 100 weight section, silica sand of six to 300 weight section, and re-emulsifiability powder resin of two to 46 weight section to cement of 100 weight sections. The polymer cement composition concerning Claim 5 contains the limestone impalpable powder of five to 100 weight section, silica sand of six to 300 weight section, the powder asphalt of two to 46 weight section, and slaked lime of 0.01 to 5 weight section to cement of

100 weight sections.

[0013]The desirable content of limestone impalpable powder is 20 to 60 weight section in Claim 1, and 2 and 5. Only in the case of Claim 2, it is 13 to 50 weight section, and, other Claim 1 and in the case of 4 and 5, the desirable content of silica sand is 26 to 100 weight section. In the case of Claim 2, in the case of 13 to 50 weight section, and Claim 3, the desirable content of limestone aggregate is 26 to 100 weight section. The desirable content of re-emulsifiability powder resin is 1.5 to 15 weight section in Claims 1-4. The desirable content of the fly ash of Claim 3 is 20 to 60 weight section. The desirable content of the blast furnace slag of Claim 4 is 20 to 60 weight section. The desirable content of the powder asphalt of Claim 5 and slaked lime is 1.5 to 15 weight section, and 0.05 to 1.0 weight section, respectively.

[0014]\*\*\*\*\* in which limestone impalpable powder is good at less than the above-mentioned lower limit neither not being obtained nor the cement milk for osmosis whitens, but if the above-mentioned upper limit is exceeded, the fault to which intensity manifestation nature falls will be produced. In less than the above-mentioned lower limit, desired mobility is not obtained, but silica sand will produce the fault to which intensity manifestation nature falls, if the above-mentioned upper limit is exceeded. If description is not improved by less than the above-mentioned lower limit but limestone aggregate exceeds the above-mentioned upper limit, the fault to which intensity manifestation nature falls will be produced. If it becomes easy to generate a crack in less than the above-mentioned lower limit and re-emulsifiability powder resin exceeds the above-mentioned upper limit, the fault to which intensity manifestation nature falls will be produced. If mobility is not improved by less than the above-mentioned lower limit but fly ash exceeds the above-mentioned upper limit, the fault to which intensity manifestation nature falls will be produced. If the cement milk for osmosis does not whiten by less than the above-mentioned lower limit but blast furnace slag exceeds the above-mentioned upper limit, the fault to which intensity manifestation nature falls will be produced. Less than the above-mentioned lower limit of the resistance over a crack is insufficient, and powder asphalt will produce the fault to which intensity manifestation nature falls, if the above-mentioned upper limit is exceeded. The effect that slaked lime corrects curing retardation sufficient by less than the above-mentioned lower limit is not acquired, but if the above-mentioned upper limit is exceeded, premature hardening will be carried out, and the fault from which good mobility is not obtained is produced.

[0015]Each material is explained in full detail through the polymer cement composition concerning Claim 1 thru/or Claim 5. According to the curing time asked for traffic opening, ordinary portland cement, high-early-strength Portland cement, blended cement, and regulated set cement are used for cement of this invention. These may be used together. Or quick-hardening-ized material may be added to high-early-strength Portland cement, and it may be

used for it as regulated set cement. When using regulated set cement, injection work can be secured using setting modifiers, such as hydroxy acid or its salt, alkaline metal salt, an aluminate, and sulfate. In regulated set cement. \*\* Grind until it adds 0.5 to retarding admixture 5 weight section to the gross weight of ten to II type anhydrous gypsum 30 weight section, 20 to steel-manufacture slag 50 weight section, and these ingredients to 20 to portland cement or blended cement 70 weight section and specific surface area is set to  $3500 \text{ cm}^2/\text{g}$ , What mixed portland cement or blended cement of the above-mentioned rate into this fines mixture (quick-hardening cement given in JP,S62-260749,A), \*\* Portland cement. To or blended cement 100 weight section. 0.5 to setting modifier 5 weight section which consists of organic system retarding admixture like ten to stainless steel steel-manufacture slag 70 weight section and four to II type anhydrous gypsum 40 weight section by which a byproduction is carried out by aluminum use at the deoxidation process of a stainless steel steel-manufacture refinement process, and tartaric acid, and alkali carbonate like sodium carbonate. After mixing, the fast-curing material of the thing (fast-curing constituent given in JP,H6-321607,A) which ground this mixture, or a calcium aluminate system of \*\* marketing can be used.

[0016]Any of molding sand, beach sand, river sand, and natural sand may be used for silica sand of this invention. Comparatively fine silica sand of about No. 7 is preferred. As re-emulsifiability powder resin of this invention, commercial vinyl acetate system resin powder is mentioned. For example, resin powder, such as ethylene-vinyl acetate resin, carboxylic acid denaturation vinyl acetate resin, Veova denaturation vinyl acetate resin, an acetic acid acrylic ester copolymer, and a pure acrylic resin, is mentioned. limestone impalpable powder and blast furnace slag -- specific surface area of cement by blaine (specific surface area) --  $1000\text{--}6000 \text{ cm}^2/\text{g}$  -- the granular material of  $2000\text{--}4500 \text{ cm}^2/\text{g}$  is used preferably. As for limestone aggregate, particle diameter uses a 0.05-0.6-mm thing preferably 0.01-1.0 mm. As for powder asphalt, mean particle diameter uses 20-60 micrometers of 30-50-micrometer things preferably. As for slaked lime, particle diameter uses a thing of 0.05 mm or less preferably 0.1 mm or less.

[0017]As a granular material additive agent of this invention, a water reducing agent, a defoaming agent, and a thickening agent are mentioned. Leading the polymer cement composition concerning Claim 1 thru/or Claim 5, as for 0.1 to 10 weight section, and a defoaming agent, in a water reducing agent, 0.01 - the amount part of duplexes, and a thickening agent are 0.01 - 3.0 \*\*\*\*\* rare \*\* to cement 100 weight section to these constituents. By less than these lower limits, when the performance of each request is not revealed and upper limit is exceeded, in the case of a water reducing agent, there is a possibility that the curing retardation of segregation is produced, and in the case of a defoaming agent may produce curing retardation, and may produce curing retardation in the case of a thickening agent, and mobility may fall. As a water reducing agent, a lignosulfonic

acid salt, oxy organic acid salt, beta naphthalenesulfonic acid salt, polycarboxylic acid salt, melamine resin sulfonate, a creosote oil sulfonic acid condensation product salt, etc. are mentioned. As a defoaming agent, ether, fatty acid ester, fatty acid amide, higher alcohol, a high polymerization glycol, and silicone are mentioned. In this, a non-ion system or a silicone series is preferred. As a thickening agent, cellulose, such as hydroxyethyl cellulose, methyl cellulose, and hydroxymethylcellulose, are mentioned.

[0018]In order to prepare a 1 powder type polymer cement composition of this invention, dry blending of each material is carried out with usual powder-mixing equipment, such as a V type mixer, a vertical mold mixer, and an omnipotent mixer. Construction of half-flexible pavement which used a 1 powder type polymer cement composition of this invention, receiving 1 powder type polymer cement composition 100 weight section, after paving with an open grain size asphalt mixture used as a parent -- water -- 20 to 60 weight section, 25 to 50 weight section is preferably mixed by a portable mixer etc., and cement milk for osmosis (grout) is prepared. After an open grain size asphalt mixture with which it paved will be 50 \*\* or less, this cement milk for osmosis (grout) is sprinkled, and it is carried out by extending by a rubber rake and making an open grain size asphalt mixture permeate with a vibratory roller.

[0019]

[Working example]Next, working example of this invention is described with a comparative example.

To <working example 1> ordinary-portland-cement 100 weight section, specific surface area of cement by blaine extracted limestone impalpable powder 35 weight section of  $3000\text{ cm}^2/\text{g}$ , and the silica sand No. 7 40 weight sections in a container of an omnipotent mixer, attached an impeller, and agitated for 10 minutes at first at a low speed. In this container, as re-emulsifiability powder resin Then, acrylic copolymerization resin powder 4 weight section, As powder additives, high-range water reducing agent (melamine resin sulfonic acid condensation product salt) 0.9 weight section, Powder defoaming agent (non-ion system) 0.1 weight section and thickening agent (hydroxyethyl cellulose) 0.02 weight section were put in, an agitating speed was made high-speed, agitation mixing was carried out for 20 minutes, a 1 powder type polymer cement composition for half-flexible pavement was prepared, and this was put into a well-closed container.

[0020]Instead of extracting 40 weight sections of the <working example 2> silica sand No. 7, except having extracted 20 weight sections of silica sand No. 7 for limestone aggregate whose mean particle diameter is 0.3 mm with 20 weight sections, the 1 powder type polymer cement composition for half-flexible pavement was prepared like working example 1, and this was put into the well-closed container.

Instead of extracting 35 weight sections of the <working example 3> limestone impalpable powder, fly ash 35 weight sections, Instead of extracting 40 weight sections of silica sand No.

7, except having each extracted the limestone aggregate ground to the following of 0.3 mm 40 weight section, the 1 powder type polymer cement composition for half-flexible pavement was prepared like working example 1, and this was put into the well-closed container.

[0021] Instead of extracting 35 weight sections of the <working example 4> limestone impalpable powder, except that specific surface area of cement by blaine extracted 35 weight sections of blast furnace slag of  $3000 \text{ cm}^2/\text{g}$ , the 1 powder type polymer cement composition for half-flexible pavement was prepared like working example 1, and this was put into the well-closed container.

Instead of extracting 35 weight sections of the <comparative example 1> limestone impalpable powder, except having extracted 35 weight sections of fly ash, the 1 powder type polymer cement composition for half-flexible pavement was prepared like working example 1, and this was put into the well-closed container.

As opposed to the ordinary-portland-cement 100 same weight section as <comparative example 2> working example 1, After extracting and agitating the silica sand No. 7 29 weight sections in a container like working example 1, as re-emulsifiability powder resin in this container continuously Acrylic copolymerization resin powder 3 weight section, The water reducing agent 0.5 weight section respectively same as powder additives as working example 1 and defoaming agent 0.1 weight section were put in, the agitating speed was made high-speed, agitation mixing was carried out for 20 minutes, the 1 powder type polymer cement composition for half-flexible pavement was prepared, and this was put into the well-closed container.

[0022] Instead of extracting four weight sections of the <working example 5> re-emulsifiability powder resin, four weight sections of powder asphalt whose mean particle diameter is 41 micrometers is extracted, The quantity of a thickening agent was increased from 0.02 weight sections to 0.04 weight sections, and also 0.3 weight-section \*\*\*\*\* prepared the 1 powder type polymer cement composition for half-flexible pavement for slaked lime like working example 1, and this was put into the well-closed container.

[0023] Except adding no <comparative example 3> slaked lime, the 1 powder type polymer cement composition for half-flexible pavement was prepared like working example 5, and this was put into the well-closed container.

Except having made the addition of the <comparative example 4> thickening agent into 0.02 weight sections, the 1 powder type polymer cement composition for half-flexible pavement was prepared like working example 5, and this was put into the well-closed container. The contents of combination of working example 1-5 and the comparative examples 1-4 are shown in Table 1.

[0024]

[Table 1]

(単位：重量部)

	普通セメント	石灰石微粉末	フライアッシュ	高炉スラグ	石灰石骨材	珪砂7号	再乳化性粉体樹脂	粉末アスファルト	減水剤	消泡剤	増粘剤	膨潤灰
実施例	1	100	35	—	—	40	4	—	0.9	0.1	0.02	—
	2	100	35	—	—	20	20	4	—	0.9	0.1	0.02
	3	100	—	35	—	40	—	4	—	0.9	0.1	0.02
	4	100	—	—	35	—	40	4	—	0.9	0.1	0.02
	5	100	35	—	—	—	40	—	4	0.9	0.1	0.04
比較例	1	100	—	35	—	—	40	4	—	0.9	0.1	0.02
	2	100	—	—	—	—	29	3	—	0.5	0.1	—
	3	100	35	—	—	—	40	—	4	0.9	0.1	0.04
	4	100	35	—	—	—	40	—	4	0.9	0.1	0.02

[0025] 1 powder type polymer cement composition 100 weight section for half-flexible pavement of <mull of grout> working example 1-5 and the comparative examples 1, 3, and 4 is supplied to water 45 weight section, respectively, 1 powder type polymer cement composition 100 weight section for half-flexible pavement of the comparative example 2 was supplied to water 50 weight section, according to each, it mixed uniformly by the mixer and nine kinds of cement milk for osmosis (grout) was prepared.

[0026] It examined according to the <physical properties (a) of grout and test piece> mobility (flow) test soil tree society standard "fluidity test method (method by P funnel) of the grouting mortar of preplaced aggregate concrete (JSCE-F 521-1994)." That is, the grout immediately after the mull obtained from the 1 powder type polymer cement composition of working example 1-5 and the comparative examples 1-4 and the grout after mulling and 20 minutes pass were poured out in the funnel supported perpendicularly, each flow value was calculated, and the mobility was evaluated. The result is shown in Table 2.

(b) About separation situation working example 1 and 5 and the comparative examples 3 and 4, such as resin, the grout immediately after a mull was put into the beaker, and the situation which re-emulsifiability powder resin and powder asphalt separate from grout after 180-minute progress was observed by viewing. The result is shown in Table 2.

[0027] (c) The strength test was done according to measurement "physical-test method (JIS R5201-1992) of cement" of a strength test and the rate of drying shrinkage. That is, the test piece of the with a 40 mm of section [ square and 160 mm in length ] square pillar was produced from the grout immediately after the mull obtained from the 1 powder type polymer cement composition of working example 1-5 and the comparative examples 1-4. When the age of the test piece was 24 hours, three days, seven days, and 28 days, it measured each three test pieces at a time about bending strength and compressive strength. It asked for the rate of drying shrinkage by the dimensional change from a dry start time when the drying period of a



test piece turns into four weeks according to the length change testing method (JIS A 1129-1993) of mortar and concrete about working example 1-4 and the comparative examples 1 and 2. The average value is shown in Table 2.

[0028]

[Table 2]

		70-μ (s)					流動長さ(N/mm <sup>2</sup> )				圧縮長さ (N/mm <sup>2</sup> )				乾燥 収率(%)	樹脂の 分離
		直後	20分後	24h	3d	7d	28d	24h	3d	7d	28d	24h	3d	7d		
実施 例	1	10.5	10.8	1.9	4.1	4.8	5.1	6.8	20.7	25.0	33.3	0.25	なし			
	2	10.0	10.3	2.0	4.0	4.8	5.1	7.1	21.4	25.4	33.0	0.20	—			
	3	11.0	11.3	1.6	3.9	4.4	5.2	4.5	17.2	23.8	35.2	0.23	—			
	4	11.8	12.2	1.5	3.5	4.7	6.0	4.3	15.3	24.9	37.5	0.29	—			
	5	10.7	11.1	2.3	4.2	5.0	—	—	—	—	—	—	なし			
比較 例	1	11.6	12.0	1.3	3.4	4.4	5.4	4.1	15.9	24.0	35.6	0.26	—			
	2	11.9	12.4	1.4	4.5	4.9	5.0	5.4	20.2	25.8	29.9	0.41	—			
	3	10.6	10.9	1.0	2.4	3.7	—	—	—	—	—	—	なし			
	4	10.0	10.1	1.1	2.6	3.8	—	—	—	—	—	—	あり			

[0029]The following thing became clear from Table 2. In working example 1 which replaced some cement in the comparative example 2 with limestone impalpable powder, mobility was able to improve compared with the comparative example 2, the water granular material ratio for acquiring a desired flow could be fallen to 45% from 50%, and, thereby, drying shrinkage has been reduced. Since the color of grout became white, color enhancement became good when coloring. In working example 2 which replaced the moiety of the silica sand No. 7 in working example 1 by limestone aggregate, a flow and intensity manifestation nature improved a little compared with working example 1. In working example 3 which replaced silica sand in the comparative example 1 by whole-quantity limestone aggregate, and uses fly ash, a flow and early age strength improved a little compared with the comparative example 1.

[0030]In working example 4 which used blast furnace slag instead of the fly ash of the comparative example 1, the intensity on age the 28th improved a little compared with the comparative example 1. In the comparative example 4 with few rates of a thickening agent, in order that powder asphalt with light specific gravity might float in the grout surface, separation of resin etc. was seen and curing retardation was caused. On the other hand, the quantity of a thickening agent was increased, and in working example 5 which added slaked lime, separation of resin etc. was not seen but showed intensity manifestation nature equivalent to working example 1.

[0031]

[Effect of the Invention]According to this invention, as stated above, it can prepare promptly in

a construction site, and common or even when [ which added regulated set cement or sudden hardening material with cement ] high-early-strength Portland cement is used, the adverse effect on construction of the cement milk for osmosis can be stopped to the minimum. A compounding error is not started even if authorized personnel are unripe. It excels in mobility, and a water granular material ratio is reduced, and drying shrinkage can be made small, and it excels in intensity manifestation nature. In order that the cement milk for osmosis may whiten, color enhancement becomes good when coloring.

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[Translation done.]